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Decision Making and Risk in Bipolar Disorder: A quantitative study using Fuzzy Trace

Theory

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Abstract

Objectives: This study characterises risk-taking behaviours in a group of people with a self-reported diagnosis of BD using Fuzzy Trace Theory (FTT). FTT hypothesises that risk-taking is a “reasoned” (but sometimes faulty) action, rather than an impulsive act associated with mood fluctuations.

Design: We tested whether measures of FTT (verbatim and gist-based thinking) were predictive of risk-taking intentions in BD, after controlling for mood and impulsivity. We hypothesised that FTT scales would be significant predictors of risk-taking intentions even after accounting for mood and impulsivity.

Methods: 58 participants with BD (age range 21 to 78, 68% female), completed a series of online questionnaires assessing risk-intentions, mood, impulsivity and FTT.

Results: FTT scales significantly predicted risk-taking intentions (medium effect sizes), after controlling for mood and impulsivity consistent with FTT (*part* range .26 to .49). Participants with BD did not show any statistically significant tendency towards verbatim-based thinking.

Conclusions: FTT gist and verbatim representations were both independent predictors of risk-taking intentions, even after controlling for mood and impulsivity. The results offer an innovative conceptualisation of the mechanisms behind risk-taking in BD.

Keywords: bipolar disorder, risk taking, decision making, fuzzy trace theory, impulsivity

Practitioner Points:

- Risk-taking behaviour in bipolar disorder is not just a consequence of impulsivity
- Measures of fuzzy trace theory help to understand risk-taking in bipolar disorder
- FTT measures predict risk-taking intentions, after controlling for mood and impulsivity

Decision Making and Risk in Bipolar Disorder: A quantitative study using Fuzzy Trace Theory

People diagnosed with bipolar disorder (BD), a condition predominantly characterised by a difficulty in emotion regulation and impairments in cognitive processing (Phillips, Ladouceur and Drevets, 2008), are particularly prone to risk-taking behaviours (Chandler et al., 2009). These behaviours can manifest in severe forms such as substance use and alcohol abuse, crimes, sexual promiscuity and unwise financial activities (Fazel, Lichtenstein, Grann, Goodwin, and Långström, 2010; Kopeykina et al., 2016; McIntyre et al., 2007; Wilens et al., 2004) with serious consequences at the individual and societal levels (Dalton, Cate-Carter, Mundo, Parikh, and Kennedy, 2003; Meade, Graff, Griffin and Weiss, 2008).

Psychological models have explored how these behaviours develop in BD, in particular exploring the role of factors such as impulsivity and manic type experiences (Holmes et al., 2009; Johnson, 2005). Nonetheless, conceptualising risk-taking behaviours as simply the result of mood states and/or impulsivity can limit our understanding of more complex psychological processes that have been found to guide these behaviours in a range of clinical and non-clinical populations.

Fuzzy Trace Theory (FTT) (Brainerd and Kingma, 1984; Brainerd and Reyna, 1992), offers a new conceptualisation of the mechanisms behind risk-taking behaviours that could be relevant for BD, because rather than understanding risk taking as a function of impulsivity, mood, or arousal, FTT frames risk taking as the result of a “reasoned” (but sometimes faulty) process, with potential practical clinical implications.

FTT is a theory of memory processing, which posits that when people are exposed to a meaningful stimulus in their daily lives, they encode their memories of those experiences

using a temporally parallel, dual-processing method, in the form of both verbatim and gist representations (Reyna, 2008, 2004; Reyna and Rivers, 2008).

Verbatim representations are recorded as similarly as possible to the original experience, (i.e., it is literal, or in other words, verbatim). These representations are more difficult to remember accurately and may thus also be altered by post-stimulus emotions in a given situation. Conversely, a gist representation is more qualitative and captures what the person perceives as the “bottom line” meaning of the information recorded. Gist representations are often subjective, and can be influenced by several factors including the person’s emotional state at the time of the stimulus, educational or cultural background and their developmental stage (e.g., adulthood vs adolescence) (Reyna and Brainerd, 1995).

Some other models propose similar mechanisms of memory as FTT. The dual representation model juxtaposes two ways of encoding memories: conscious, voluntary, verbally accessible memories (VAMs) with high potential for alteration over time, and unconscious, emotional, situationally accessible memories (SAMs), focused on meaning making or judgment (Brewin, Dagleish and Joseph, 1996). These components resemble verbatim and gist respectively. Despite the parallels and merits, this model is ultimately situated in Post-Traumatic Stress Disorder research, and does not broach decision-making or risk in its scope. A theory that allows an integration of memory processing theories, decision-making, and risk could serve as particularly useful in investigating a risk-taking population such as those with BD.

FTT fills this gap by demonstrating how memories and analytical thinking, as opposed to intuitive thinking, can lead to risk-taking behaviours. When a risk-taking decision is presented, FTT states that the individual retrieves either gist or verbatim memories to make an informed decision, and that this retrieval is impacted by their mental processes and other environmental factors or cues (such as age, emotions, and other stimuli).

According to FTT, analytical (verbatim) thinking is considered faulty due to its disregard of the bottom-line (gist) meaning of the information presented. Verbatim-based thinking leads to an overestimation of the benefits or an underestimation of the risks of a decision. For example, in deciding whether to begin smoking or not, being told that smoking accounts for 30% of all cancer-related deaths may lead an individual to believe that 30% is not a lot, compared to the other 70%. Though precise and analytical, this type of belief demonstrates a “reasoned route” to risk-taking (Reyna, 2004; Reyna and Brainerd, 1995). Comparatively, the knowledge that, overall, smoking is dangerous for one’s health, is ultimately a less risky observation. In this way, though counter-intuitive, an over-reliance on precise, verbatim-based thinking rather than fuzzy, gist-based thinking increases the likelihood of making a risky decision (e.g., starting to smoke, or engaging in unsafe sex). Indeed, studies completed in the field of FTT (Reyna, Weldon and McCormick, 2015; Rivers, Reyna and Mills, 2008) have found a correlation between verbatim-based thinking and higher risk-taking intentions, a relationship that has been replicated in further research on FTT.

Furthermore, the careful, analytical trade-off of risks and benefits often used to alter particular behaviours (e.g. to continue to gamble or not), may create insight that is not easily transferable into subtly different decisions. This inability to transfer insight has been hypothesised as responsible for the fade-out effect of clinical risk prevention interventions, routinely based on the assumption that teaching clients to carry out a careful trade-off of risks and benefits will decrease risk-taking (Reyna and Mills, 2014). According to FTT, the method of trading-off risks and benefits will not yield transferrable effects, but gist thinking may.

Instead of conceptualising decisions on risk-taking as impulsive versus thoughtful actions, FTT juxtaposes “deliberate” action based on faulty verbatim thinking with a more intuitive, gist-based approach, with the latter being linked to lower risk-taking (Reyna, 2004).

FTT and emotion

FTT's focus on the role of emotions in decision-making is a perspective of value considering BD. As a disorder characterised by risk-taking and emotional highs and lows, clarifying how emotions impact on decision-making processes will be beneficial to further enhance targeted psychological interventions for this population.

FTT carefully distinguishes between emotion and intuition, a distinction that appears unique in memory theories (Rivers et al., 2008). According to FTT, not all kinds of emotions are synonymous with poor decision-making. Valence, the simple evaluation of a stimulus as "good or bad" based on an intuitive "gut feeling", is a key aspect of emotion, and considered a necessary component of gist. This renders valence ultimately helpful (and not harmful) in decision-making processes (Chick and Reyna, 2012). Nonetheless, valence is determined and influenced in part by experience. Therefore, adults, who have acquired the necessary experience to trigger a negative "gut feeling", will avoid a risky situation, such as unprotected sex. However, younger populations, such as adolescents, lack this experience and thus, might have acquired a "faulty valenced conception" that unprotected sex is fun. In the absence of accurate experiential information, adolescents may (accurately) perceive the situation (unprotected sex) as positive in the short-term, given the immediate rewards of sex, underestimating the long term negative consequences of unprotected sex (e.g. unwanted pregnancies, STIs, HIV). This underestimation of risk may change subsequently when the adolescent experiences the negative consequences of these kinds of actions (e.g. sexually transmitted diseases; Rivers, Reyna and Mills, 2008).

Emotional arousal and intense emotions may also create what researchers define as "false memories" for the gist of an experience (Corson and Verrier, 2007; Kaplan, Van Damme, Levine and Loftus, 2015). The bottom-line meaning (gist) of the situation is recorded based on the emotion felt at the time of the experience. This can potentially create a

“pre-loaded” response to future risky situations that trigger similar feelings to the original event. For instance, if an individual experiences intense fear when they see a fight in a bar, this will cue them to be risk-averse; thus, if fear is re-triggered during similar sub-sequent events, a risk-averse rather than a risk-seeking response is triggered, even if the sub-sequent event might not pose the same risk as the original event. Alternatively, if anger is the dominant emotion upon seeing a fight in a bar, risk-taking rather than risk-aversion is the likely response in subsequent events (see Lerner and Keltner, 2001; Reyna and Landa, 2015; Rivers et al., 2008).

Of course, FTT is not the only memory theory that investigates the ways in which emotional elements may interact with memory formation. The Interacting Cognitive Subsystems model proposes a multilevel processing system with many interacting components, including propositional elements, responsible for the sensory aspects of memories (verbatim), and implicational components, which contribute to the “holistic”, emotional contagion of memories (a valence, or gist; Barnard and Teasdale, 1991). This system, however, does not propose parallel processing of memories, a key component of FTT, and again, does not explicitly address risk-taking.

The unique interpretation of emotion as a factor in decision-making and gist processing, leading to underestimation of risk in the formation of gist memories, makes FTT a theory of particular interest in BD.

Fuzzy Trace Theory and Bipolar Disorder

Elevated rates of risk-taking behaviours remain a significant clinical challenge in mental health services targeting people diagnosed with BD. Research on risk-taking behaviours in BD has been overwhelmingly characterised by a focus on impulsivity as a driver of risk-taking. Nonetheless, as outlined above, FTT posits that impulsivity might not

be the only driver to risk-taking and proposes a more “reasoned” route to understand risk-taking behaviours in clinical and non-clinical populations.

Emotion (in the form of valence and arousal) has been found to influence parallel processes in FTT in different ways. Emotion is both a crucial and a detrimental factor in decision-making processes. If emotional arousal has been found to contribute to “false memories” for the gist of experiences and pre-loaded responses for subsequent decisions, it can be hypothesised that in BD, which is characterised by a difficulty in regulating emotions, and thus, the experience of regular intense emotional states (Phillips, Ladouceur and Drevets, 2008), similar processes might be at play in prevalent risk-taking behaviours. Of particular relevance to this claim are risk-taking behaviours during manic states. It is understood in research and clinical practice that people with BD tend to experience positive feelings of euphoria and a sense of achievement when taking risks during manic episodes. As outlined above, positive feeling states tend to lead to more risk-taking behaviours to enhance the positive feeling, a circumstance described in cognitive models of BD as ascent behaviours (Mansell et al., 2007).

Research in FTT has found a greater influence of emotion on verbatim-based retrieval (Rivers et al., 2008). Intuitively, an overreliance on verbatim-based thinking in the presence of intense emotions would lead to increased risk-taking, a link that has been widely observed in FTT research on adolescent populations (Chick and Reyna, 2012).

Clarifying how people with BD engage in verbatim-based and gist-based thinking, could offer valuable insight into the risk-taking processes in this population.

There is emerging evidence supporting interventions informed by FTT in risk reduction programs for adolescents (Reyna et al., 2015b), health-related issues such as obesity (Brust-Renck et al., 2016), and CBT for psychosis (Landa, 2012; Landa et al., 2015). If FTT successfully explains and reduces risk in these populations and domains, it could be

effective in individuals with BD as well. In individuals with BD, an intervention of this kind, with a cognitive-behavioral approach targeting gist formation and retrieval, could lead to similar improvements in risk reduction and improve long-term efficacy of programs.

The current study

Studies of decision-making in clinical populations are valuable, because they help clarify the mechanisms behind negative outcomes and point towards the development of potential new treatments. By characterising BD using FTT, we aim not only to use a novel framework to conceptualise decision-making and risk-taking behaviours in BD, but offer potential clinical recommendations to improve treatments and outcomes in BD.

FTT is also of interest given the developmental timeline it posits. Studies on FTT have found that there is usually a shift from verbatim-based thinking to gist-based thinking during adolescence (Reyna and Mills, 2014). It is documented that the onset of BD is before the age of 21 (e.g. Ferrari et al., 2016; Grande, Berk, Birmaher and Vieta, 2016; Goldstein et al., 2017) and clinical precursors to BD have been observed in adolescence (Duffy, Alda, Crowford, Milin, and Grof, 2007; Duffy, Alda, Hajek, Sherry and Grof, 2010; Duffy et al., 2014). With the cognitive changes observed during the prodromal stages of BD (Lewandowski, Cohen and Öngur, 2011) these factors could impact the natural developmental conversion between verbatim and gist-based thinking in people diagnosed with BD.

The current study aimed to take the first step in considering FTT as a factor in risk and decision-making in BD, and characterise a group of people with a self-reported diagnosis of BD utilising this novel theory.

To achieve this aim: a) we described the patterns of response of the sample to FTT measures (i.e. gist and verbatim scales), and b) we explored whether FTT scales continued to predict risk-taking intentions after accounting for mood state and impulsivity.

We hypothesised that FTT scales would be significant predictors of risk-taking intentions even after accounting for mood and impulsivity.

Materials and Methods

Participants were recruited from social media (Twitter), UK and international charities, and client support organisations. Inclusion criteria required participants to be over the age of 18, fluent English speakers, able to provide informed consent and have a self-reported diagnosis of bipolar disorder.

Measures

Data were collected through anonymised online questionnaires using Qualtrics software (2005), Version 3.5.0, Copyright © [2017].

Demographic and clinical characteristics

Several demographic and clinical variables were collected through a questionnaire developed for this study. We asked participants about their gender, date of birth, employment and marital status, education level, ethnic background and native language. The questions were in multiple-choice format with the option of an “other” category, where participants could enter an alternative response.

Participants were asked about time of diagnosis, diagnosis type, number of episodes, current psychological interventions, and current medication. There was also a question about when the participants believed their problems with mania/depression started, since it has been observed that there can be a significant delay between onset of symptoms and diagnosis of BD (Grande, Berk, Birmaher and Vieta, 2016).

Participants were also asked whether they believed they were currently experiencing an episode of mania/depression or both and when this started, and when their last episode of mania/depression terminated.

Information about comorbid mental health diagnoses and medical conditions (including HIV/AIDS) was also collected. The HIV/AIDS questions were included to ensure the applicability of the FTT questionnaires to all participants, as the content of the questions assesses gist and verbatim based on sexual risk taking concerning the hypothetical possibility of contracting a sexually transmitted disease or becoming pregnant. Participants who indicated that they had a diagnosis of HIV/AIDS were directed to an alert informing them that the content of some of the questionnaires may not be applicable and they were asked to respond to the questions about HIV/AIDS in a hypothetical manner, i.e. as if they did not already have HIV/AIDS. Of the total number of participants, only one indicated a positive diagnosis for HIV/AIDS.

Fuzzy Trace Theory Scales

The theoretical structure of FTT necessitates the conceptualisation of gist and verbatim through the use of a specific topic. The FTT scales, developed by Mills, Reyna and Estrada (2008), focused on adolescent sexual risk taking. The context of sexual risk taking was kept for this study, to remain as close to the original questionnaires as possible, and due to the relevance of sexual risk taking concerning individuals with a diagnosis of BD (Chandler et al., 2009).

Verbatim scales. Two verbatim scales were used for the current study. The first scale, a Specific-Risk scale, comprised five items that listed concrete consequences of risky sexual behaviour (e.g., contracting HIV or sexually transmitted diseases) and asked participants to estimate the personal risk of those consequences on a 5-point scale ranging from strongly disagree to strongly agree. These items were designed to trigger verbatim memories of past

behaviours (e.g., instances where the person engaged in unprotected sex), thus involving a verbatim (or analytic) mode of thinking. The scale showed excellent reliability in our sample ($\alpha=.96$). A second verbatim scale, the Quantitative Risk Scale, was used to check the validity of the other scale, and asked participants to quantify their risk of having an STD based on their actual sexual behaviour on a scale from 0 to 100. Higher scores on the specific risk and quantitative risk scales indicate higher endorsement of verbatim principles.

Gist scales. Three gist scales were used to measure gist-based thinking (Mills et al., 2008). The Categorical Risk Scale comprised of nine items that measured categorical thinking about risk (e.g., “even low risks happen to someone”), and were rated on a 5-point scale ranging from "strongly disagree" to "strongly agree". High scores on the categorical risk scale indicate higher categorical thinking about risk. The scale showed acceptable reliability ($\alpha=.79$). The Gist Principles Scale contained 15 simple statements about risk (e.g., “avoid risk”), and participants were asked to indicate which statements applied to them (or not). High scores on the gist principles scale indicate lack of endorsement of gist principles. The scale showed good reliability in our sample ($\alpha=.80$). The final gist scale, Global Risk, asked participants to state in a single item their personal risk of having sex as “low”, “medium” or “high”. Higher scores on the global risk question indicate higher personal risk perception.

Measurement of mood

Participants' lifetime history of manic symptoms was evaluated using the Mood Disorder Questionnaire (MDQ; Hirschfeld et al., 2000), and more time-sensitive alterations in mood were assessed with the 7up 7down inventory (Youngstrom et al., 2013). The MDQ is a self-report questionnaire comprising 13 symptom items and 2 items about clustering and severity of impact, which was developed as a screening tool for BD. Participants are asked to answer "yes" or "no" to a series of questions about lifetime symptoms of mania and hypomania and subsequently indicate the degree of impairment caused by these symptoms.

Higher scores in the MDQ indicate a higher number of lifetime symptoms and degree of impairment. The typical cut-off for a positive diagnosis using the MDQ is 7 out of 13. The MDQ showed acceptable reliability in our sample ($\alpha=.71$).

The 7up 7down inventory is a measure derived from the General Behaviour Inventory (GBI). It comprises seven items asking about symptoms of mania (7up) and seven items asking about depressive symptoms (7down). Participants are asked to state how often they have experienced each symptom during the past two weeks and score each item as "never or hardly ever", "sometimes", "often", "very often" or "almost constantly" (scored 0 to 3). Higher scores in the 7up are indicative of mania, whilst higher scores in the 7down scale indicate a possible depressive state. Both the 7up ($\alpha=.93$) and 7down ($\alpha=.96$) scales showed excellent reliability in our sample.

Measurement of impulsivity

Impulsivity was measured using the simplified version of the Barratt Impulsiveness Scale (BIS-11; Spinella, 2007). The BIS-11 is a widely used measure of impulsiveness and comprises 14 items scored on a 4-point scale of "rarely/never", "occasionally", "often" and "almost always/always" (scored 1 to 4). Higher scores in the BIS-11 are indicative of higher impulsivity. The scale showed excellent reliability ($\alpha=.90$) in our sample.

Measurement of risk-taking intentions

Information about participants' risk-taking intentions was collected using the Domain Specific Risk Taking Scale for Adult Population (DOSPERT; Blais and Weber, 2006). The DOSPERT encompasses two scales measuring risk taking behaviour (RT) and risk perception (RP). Each scale comprises 30 items. We used the RT subscale in the current study, which uses a 7-point scale from "extremely unlikely" to "extremely likely" (scored 1 to 7) and asks the participants to score their likelihood to engage in each stated behaviour or activity. Higher scores in the RT subscale indicate higher risk-taking intentions. The DOSPERT_RT scale is

comprised of five further subscales evaluating risk-taking intentions in different domains: ethical ($\alpha=.65$), financial ($\alpha=.77$), health/safety ($\alpha=.72$), recreational ($\alpha=.86$) and social ($\alpha=.77$). A further subscale about sexual-risk intentions ($\alpha=.62$) was generated for the current study based on items 9 (“having an affair with a married man/woman”) and 15 (“engaging in unprotected sex”) to reflect the focus on sexual activity of the FTT scales.

Data Analyses

Data were analysed using SPSS version 22.0. We conducted descriptive and frequency analyses. We evaluated participants’ response patterns on the gist and verbatim scales via exploratory analyses, using measures of central tendency and graphical visual inspections to characterise BD in terms of endorsement of gist and verbatim principles. Finally, we ran hierarchical regression models to explore whether FTT scales predicted risk-taking intentions after controlling for mood and impulsivity. Considering the exploratory nature of this study, we did not conduct multiple test corrections.

Ethical Statement

The current study was approved by the Faculty of Health and Medicine Research Ethics Committee (FHMREC) at XXXXXXXX.

Results

Demographic and clinical variables

One hundred and ten participants accessed the online link to the study survey, of whom 78 (71%) began the survey and 58 (53%) fully completed the survey and were included for analyses. No significant differences were observed between the final sample and the 20 participants who did not complete the study, but provided demographic information, on age ($t(76)=-1.55, p=.12$), gender ($\chi^2(2)=3.50, p=.17$), or education level ($\chi^2(1)=3.46, p=.06$). An acceptable amount of data at the item level was missing for the participants included in the analyses. Demographic and clinical characteristics of the final sample are

presented in Table 1. Fifty-three participants (91%) obtained a positive screening on the MDQ (cut score > 7).

FTT Scales

The responses on verbatim scales (Specific Risk and Quantitative Risk scales) showed a trend towards low scores (Specific Risk: $M=7.10$, $SD=4.08$, range=5 to 25; Quantitative Risk: $M=.97$, $SD=2.16$, range=0 to 10), which, in accordance to the literature on FTT, indicates lack of endorsement of verbatim principles in this sample.

Regarding measures of gist, 77% scored 'low', 18% scored 'medium' and 5% scored 'high' on the Global Risk Question, indicating a general low perception of personal risk of having sex. Scores on both the Categorical Risk ($M=24.78$, $SD=5.89$, range=4 to 36) and Gist Principles Scales ($M=20.93$, $SD=3.20$, range=15 to 28) showed the widest range of responses in possible scores observed among the FTT scales.

Significant correlations between individual FTT scales range from $r_s = .53$ to $r_s = -.27$ (Table 2). Two participants were found to be outliers on the Specific Risk Scale, and were removed from correlation analyses when the Specific Risk Scale was used.

When predicting intentions to engage in risk-taking related with sex, both the Gist Principles Scale and the Specific Risk Scale (Verbatim) made significant contributions explaining variance, after controlling for mood ($part=.31$ and $part=.22$). The (hypo)manic scale (7up) also made a significant contribution ($part=.27$) to this model (Table 3, panel A). Regarding the direction of the effects, participant's endorsement of verbatim, non-endorsement of gist representations and presence of hypomanic symptoms were associated with higher risk-taking intentions in the sexual domain. The pattern of results was similar when impulsivity (BIS Total Score) was added to the model, replacing mood. Impulsivity was no longer a significant predictor of risk-taking intentions in the sexual domain when FTT

scales were entered to the model. FTT scales explained 27% of variance over and above impulsivity (Table 3, panel B).

When predicting risk-taking intentions in the ethical domain, only the Gist Principles Scale ($part=.25$) and (hypo) mania (7up; $part=.27$) were found to be significant predictors (Table 4, panel A). The same pattern was observed when impulsivity was added to the model, replacing mood; the Gist Principles Scale predicted a significant amount of variance ($part=.29$) and impulsivity also made a significant contribution to the model ($part=.42$) (Table 4, panel B).

Finally, when predicting risk-taking intentions in the health/safety domains, the opposite pattern was observed. In this model, only the Specific Risk Scale (Verbatim) made a significant contribution ($part=.24$) instead of the Gist Principles Scale, and the depression scale (7down; $part=.25$) instead of the (hypo)mania scale (7up), significantly contributed to explaining variance (Table 5, panel A). In the model that included impulsivity instead of mood, impulsivity was the strongest predictor ($part=.42$), followed by the Gist Principles Scale ($part=.24$) and the Specific Risk Scale ($part=.21$), which almost reached significance ($p=.05$) (Table 5, panel B).

These models were statistically significant, with relevant predictors showing small or medium effect sizes in the expected direction when predicting intentions to engage in risk behaviours.

Discussion

Overall, the findings of this study are promising. FTT can be used to characterise risk-taking in BD, and the FTT measures explained unique variance in risk-taking intentions that went beyond the effects of impulsivity and mood. Given the limitations of the study, it must be noted that the findings discussed are preliminary, and there is a need for replication and increased methodological stringency before more sturdy conclusions can be drawn.

However, even given the exploratory nature of this study, the authors believe that the deepened understanding of risk-reduction in BD using FTT could contribute to promising future directions for research and clinical interventions.

Characterising BD and risk-taking with FTT measures

We observed varied responses in the gist scales, and lack of endorsement of gist representations, showing that non-endorsement of verbatim was independent of endorsement of gist principles. These results may reflect how verbatim and gist representations are encoded simultaneously, but retrieved separately, depending on the stimuli presented (Rivers et al., 2008). Thus, one person can have multiple, distinct, and even contradictory, representations of the same situation, but will rely on verbatim or gist depending on a series of factors (i.e., age, emotions, stimuli). The FTT scales themselves reflect the potential for simultaneous encoding, as the items do not strictly oppose one another in content and it is conceivable that a participant would endorse items on both scales.

The associations between FTT and risk-taking were correlated in the expected direction. Namely, the endorsement of verbatim (although not common) was positively correlated with higher risk-taking intentions and the endorsement of gist principles was correlated with lower risk-taking intentions. These findings are partially consistent with other studies, which found contrasting patterns for verbatim and gist measures in relation to risk-taking (e.g., Mills et al., 2008). However, there were no significant correlations between the Categorical Risk Scale (Gist) and any of the measures of risk-taking intentions.

We also found a counterintuitive result when evaluating the association of Global Risk Question and risk; high scores on this scale were found to be positively correlated with risk-taking intentions in the sexual domain, contrary to findings reported by Mills et al., (2008), who found negative correlations between these variables. FTT provides a possible explanation: people who are more likely to take risks are prone to deny vulnerability when a

“global measure” is used, but may acknowledge their risks when cued to recall specific events in which they engaged in risk-taking behaviours. Conversely, risk-avoiders would be able to acknowledge their global risk of having sex but tend to score lower on measures asking for specific risk-taking as they have less events to recall (Reyna et al., 2015b; Reyna and Brainerd, 1995). In addition, demographic characteristics (age, gender) of our sample might have also contributed to the above result.

Do FTT measures predict risk-taking intentions?

The main findings of the current study indicate the unique predictive value of the verbatim (Specific Risk Scale) and gist scales (Gist Principles Scale) when predicting risk-taking intentions after controlling for mood or impulsivity. Endorsement of verbatim and gist principles explained a statistically significant amount of variance (medium effect sizes) in risk-taking intentions in this sample. These results were in the expected direction (e.g. reliance on verbatim indicating higher risk-taking), supporting our main hypothesis that risk-taking is not simply a result of impulsive behaviours or mood fluctuations typical of BD, but a combination of these and other complex processes involved in decision-making (Mills et al., 2008; Reyna, 2008; Reyna and Brainerd, 1991).

One important finding is that the reasoning process triggered by stimuli related to sex (item content of FTT scales) was capable of predicting risk-taking intentions in other domains such as ethical and health/safety. This indicates that despite variations in content, the activation of certain cognitive patterns may impact a broader range of decisions.

The opposing pattern of predictors and outcomes in our sample, with gist (but not verbatim) predicting risk-taking intentions in the ethical domain, and verbatim (but not gist) predicting risk-taking intentions in the health/safety domains can be explained by past research. Significant differences in predictors of risk-taking intentions across different domains of risk taking (e.g. sexual, financial, health and safety) have already been observed

(e.g., Blais and Weber, 2006), suggesting that the processes underlying risk-taking intentions in specific domains might be different.

For example, ethical decisions have been hypothesised to be fundamentally different from other types of decisions, as the choices made may directly benefit or harm others (Crossan et al., 2013). Therefore, ethical decisions are usually based on a person's internal "ethical code", and have been found to be overwhelmingly dominated by "intuition" rather than "rationality" (Rand et al., 2014). Thus, in ethical decisions, individuals may rely on intuitive gist representations rather than verbatim, as reflected in the results of the study.

Conversely, decisions concerning health/safety are usually based on precise information – e.g. risk percentages when trying to consider the lifetime prevalence of a health condition – and thus are more likely to cue verbatim representations when the person is faced with a decision (Reyna, 2008), supporting our finding that verbatim-based processes (not gist) predicted health/safety risk intentions.

Replication of these results is naturally necessary to parse out subtle differences between predictors when explaining variance on different domains of risk-taking intentions.

Clinical implications

Using FFT theory, clinicians may wish to consider preventative approaches aimed at modifying whether the person relies on verbatim/gist representations during decision-making. Research on FTT has already found promising results in risk-reduction in the adolescent population (Reyna and Adam, 2003; Reyna and Mills, 2014). An intervention in adolescents using the principles of FTT was effective in reducing risky sexual behavior above and beyond a simple risk reduction intervention and a control group. Since values inform gist representations and are key to the long-lasting nature of this kind of risk prevention, the intervention focused on promoting extraction of bottom-line, gist meaning, automatic retrieval of relevant personal values and automatic application of values to gist

representations (Reyna and Mills, 2014). By working with patients to increase gist representation and recognition of bottom-line arguments pertaining to risky actions, risky behaviour can potentially be reduced. With the support of studies such as the current one, it may be possible to implement similar approaches for individuals with BD.

Most importantly, our findings might help explain why current interventions to prevent risk-taking in BD are not effective for every person. In fact, risk-prevention interventions for BD are often based on the idea that by providing the client with detailed information about the risks and benefits of their behaviours, they will be more likely to avoid risky choices. However, we have observed how this approach, based on the idea that optimal decision-making is a result of a careful trade-off of risks and benefits (as reflected in verbatim representations), may actually cause opposite effects (i.e. more risk-taking) according to FTT (Mills et al., 2008; Reyna and Adam, 2003; Reyna and Farley, 2006). In relying on verbatim-based thinking, although people may be able to correctly recall the specific facts related to a situation, they may still fail to derive the bottom-line meaning of the situation presented to them, which is key to informed decision-making (Reyna, 2008). Thus, clinicians may wish to consider a new conceptualisation of risk and a re-evaluation of current preventative programs for people diagnosed with BD, informed by the principles of FTT.

Limitations

The current study has some limitations. First, it is important to note that due to the online recruitment strategy, the current study might have a bias toward a group of people with relatively high functioning and might have missed potential participants who were toward the lower functioning end of the spectrum. Preliminary analyses comparing participants who completed the study and those who did not showed non-significant differences on a series of variables (e.g., age, diagnosis type, level of education).

Nonetheless, the sample of the current study predominantly comprised of people from white

ethnic background and who had completed some form of higher education, which could have impacted on the results of the study.

It is also important to outline that the available clinical information (including BD diagnosis) was self-reported; thus, there was no objective evidence to confirm diagnosis of BD and other clinical variables (91% obtained a positive screening on the MDQ). Future studies may wish to consider face-to-face methods of evaluation to overcome these limitations. A comparison group (non-clinical and/or non-BD) would be a valuable contribution to this line of research.

Second, due to the relatively small number of participants, the number of variables entered into the regression models was limited to ensure statistical power. This made it difficult to explore the effects of clinical and demographic variables such as age on the predictive value of FTT scales regarding risk-taking intentions. It would be beneficial to replicate this study in a larger sample size with more controls for potentially confounding variables.

Third, it is important to take into account that the FTT scales used in the current study were specifically designed to test risk-taking intentions in an adolescent sample (see Mills et al., 2008). Thus, it is possible that this influenced the results in the current study, which involved a sample of an older age group. Further research may wish to use a scale that is better adapted to BD or adult populations, or recruit diverse samples of younger and older participants to offer potential comparisons between age group and clarify patterns of response in FTT measures.

Conclusions

This study showed promising results in explaining the links between FTT measures and risk-taking intentions in BD. The main finding was that gist and verbatim representations are both independent predictors of risk-taking intentions, even after controlling for mood and

impulsivity. FTT offers a new more complex framework of the mechanisms behind risk-taking in BD, in addition to the traditionally cited mechanisms of impulsivity and mood fluctuations. Ultimately, this research offers investigators new avenues to explore, clinicians novel conceptualizations of patient behaviour, and patients potential for relief from the negative consequences of risky behaviours.

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Table 1. Demographic and clinical information

Variable	
Age, <i>Mean(SD), [Range]</i>	49 (15), [21-78]
Female, <i>n (%)</i>	39 (68)
In employment/Students, <i>n (%)</i>	34 (59)
Native English Speakers, <i>n (%)</i>	50 (86)
Attended Higher Education, <i>n (%)</i>	49 (85)
Ethnicity, <i>n (%)</i>	
White British/White Other	49 (85)
Asian	3 (5)
Mixed	1 (2)
Black/African/Caribbean	1 (2)
Other Ethnic Background	4 (7)
Time since diagnosis, <i>n (%)</i>	
In the past year	3 (5)
In the past 2-5 years	13 (23)
In the past 6-10 years	15 (26)
In the past 11-15 years	10 (17)
More than 16 years ago	17 (29)
Diagnosis Type, <i>n (%)</i>	
Bipolar Type I	19 (33)
Bipolar Type II	27 (46)
Bipolar NOS	11 (19)
Schizoaffective Disorder	1 (2)
Number of BD episodes experienced, <i>n (%)</i>	
Between 0-5 episodes	16 (28)
Between 6-10 episodes	16 (28)
Between 11-20 episodes	8 (14)
More than 20 episodes	18 (31)
Currently in psychological therapy, yes, <i>n (%)</i>	11 (19)
Cognitive Behavioural Therapy	2 (3)
Counselling	2 (3)
Psychotherapy	3 (5)
Other/Not specified	4 (7)
Currently receiving BD medication yes, <i>n (%)</i>	48 (83)
Combination	28 (62)
Mood Stabilizers	10 (22)
Antipsychotics	4 (9)
Antidepressants	2 (3)

Currently experiencing a mood episode yes, <i>n</i> (%)	35
Last mood episode more than 6 months ago, <i>n</i> (%)	24
Other comorbid diagnoses yes, <i>n</i> (%)	23

Table 2. Correlations between FTT scales

Scale	CategRisk	GistPrinc	GlobalRisk [¥]	SpecRisk [¥]	QuantRisk [¥]
Categorical Risk	-	-.18	-.01	-.27*	-.21
Gist Principles	-.18	-	.29*	.21	.35**
Global Risk [¥]	-.01	.29*	-	.26	.29*
Specific Risk [¥]	-.27*	.21	.26	-	.53**
Quantitative Risk [¥]	-.21	.35**	.29*	.53**	-

Note: * $p < .05$ ** $p < .01$ *** $p < .001$; ; SpecRisk = Specific Risk Scale; Quant = Quantitative Risk Scale; CategRisk = Categorical Risk Scale; GistPrinc = Gist Principles Scale; GlobalRisk = Global Risk Question.

[¥]Spearman's rho

Table 3. Hierarchical Regression model for FTT scales, mood and impulsivity predicting DOSPERT Sex Subscale

Variables Panel A	R ²	ΔR	B (SE)	95% Confidence Interval	
				Lower	Upper
Step1 – Intercept	.29	.29***	.77 (1.44)	-2.11	3.65
7up – (hypo)mania			.29 (.08)	.12	.45
7down - Depression			.17 (.07)	.03	.31
Step 2 – Intercept	.44	.16**	-7.39 (2.63)	-12.68	-2.10
7up – (hypo)mania			.20 (.08)	.04	.35
7down - Depression			.09 (.07)	-.04	.22
Gist Principles			.38 (.13)	.12	.64
Specific Risk			.39 (.19)	.02	.76

Note: Overall Model - $F(4, 51)=10.17, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$;

Variables Panel B					
Step1 – Intercept	.10	.10*	3.15 (1.61)	-.08	6.39
BIS Total Score			.13 (.05)	.03	.24
Step 2 – Intercept	.37	.27***	-7.99 (2.85)	-13.72	-2.27
BIS Total Score			.07 (.05)	-.02	.17
Gist Principles			.47 (.13)	.21	.73
Specific Risk			.47 (.19)	.08	.85

Note: Overall Model - $F(3, 52)=10.54, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$

Table 4. Hierarchical Regression model for FTT scales and mood predicting DOSPERT

Ethical Subscale

Variables Panel A	R ²	ΔR	B (SE)	95% Confidence Interval	
				Lower	Upper
Step1 – Intercept	.22	.22**	6.94 (2.82)	1.28	12.60
7up – (hypo)mania			.52 (.16)	.20	.85
7down - Depression			.21 (.14)	-.06	.48
Step 2 – Intercept	.33	.11*	-5.73 (5.42)	-16.61	5.15
7up – (hypo)mania			.38 (.16)	.06	.70
7down - Depression			.08 (.13)	-.19	.35
Gist Principles			.58 (.27)	.04	1.12
Specific Risk			.67 (.38)	-.10	1.43

Note: Overall Model - $F(4, 51)=6.26, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$;

Variables Panel B

Step1 – Intercept	.29	.29***	4.69 (2.69)	-.71	10.08
BIS Total Score			.42 (.09)	.24	.60
Step 2 – Intercept	.42	.13**	-10.20 (5.14)	-20.52	.12
BIS Total Score			.34 (.09)	.17	.52
Gist Principles			.65 (.24)	.17	1.12
Specific Risk			.56 (.35)	-.14	1.25

Note: Overall Model - $F(3, 52)=12.79, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$

Table 5. Hierarchical Regression model for FTT scales and mood predicting DOSPERT

Health/Safety Subscale

Variables Panel A	R ²	ΔR	B (SE)	95% Confidence Interval	
				Lower	Upper
Step1 – Intercept	.23	.23**	8.55 (3.34)	1.85	15.25
7up – (hypo)mania			.42 (.19)	.04	.80
7down - Depression			.48 (.16)	.16	.80
Step 2 – Intercept	.33	.10*	-3.98 (6.47)	-16.97	9.02
7up – (hypo)mania			.26 (.19)	-.12	.64
7down - Depression			.34 (.16)	.02	.67
Gist Principles			.50 (.32)	-.14	1.15
Specific Risk			.95 (.46)	.03	1.86

Note: ¹Overall Model - $F(4, 51)=6.31, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$;

Variables Panel B

Step1 – Intercept ²	.29	.29***	6.68 (3.22)	.23	13.14
BIS Total Score			.51 (.11)	.29	.72
Step 2 – Intercept	.42	.13**	-9.54 (6.19)	-21.96	2.89
BIS Total Score			.41 (.10)	.20	.62
Gist Principles			.65 (.28)	.09	1.22
Specific Risk			.83 (.42)	-.01	1.67

Note: Overall Model - $F(3, 52)=12.43, p<.001$; * $p<.05$, ** $p<.01$, *** $p<.001$